25 1979 (FOUO 2/79) 1 OF 1

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JPRS L/8244

25 January 1979

USSR

TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS
(FOUO 2/79)

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BIBLIOGRAPHIC DATA SHEET	1. Report No. JPRS L/ 8244	2.	3. Recipient's Accession No.

4. Title and Subtitle
TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS, (FOUO 2/79)

5. Report Date
25 January 1979

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Joint Publications Research Service
1000 North Glebe Road
Arlington, Virginia 22201

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
As above

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

This serial report contains information on the development and productivity of the automotive and tractor industry; chemical industry and chemical machinery output; electronic and precision equipment; metallurgy and metalworking equipment; construction equipment and building materials.

17. Key Words and Document Analysis. 17a. Descriptors

USSR
Automotive Industry
Agricultural Machinery
Chemical Industry
Construction
Construction Materials
Construction Equipment
Electronics Industry
Metallurgy
Metalworking Equipment
Economics

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group 2C, 5C, 7A, 11F, 13C, 13F, 13H, 13I, 13M

18. Availability Statement
FOR OFFICIAL USE ONLY. Limited Number of Copies Available From JPRS

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 46

22. Price

FORM NTIS-35 (REV. 3-72) THIS FORM MAY BE REPRODUCED USCOMM-DC 14952-P72

JPRS L/8244

25 January 1979

TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS

(FOUO 2/79)

CONTENTS

CONSTRUCTION, CONSTRUCTION MACHINERY,
AND BUILDING MATERIALS

REGIONAL DIFFERENCES IN CONSTRUCTION COSTS

Moscow VOPROSY EKONOMIKI in Russian No 11 1978 pp 13-23

[Article by G. Khaykin: "Regional Differences in Estimated Construction Costs"]

[Text] The solution of the tasks assigned by the 25th CPSU Congress with regard to increasing production efficiency and work quality is inextricably linked with the utilization of commodity-monetary relations and with the improvement of the entire system of economic levers to influence production--profits, credit, prices, etc.--which have taken on new content under the conditions of socialism.

One of the key questions of economic policy and practice at the present stage of the national economy's development is further improvement of the system of prices and price formation. Serving as the basis for wholesale prices are the economically grounded branch outlays for production output, reflecting the present-day level of equipment, technology, and production organization. Moreover, in the branches of the extraction industry (coal, lumbering, mining, the extraction of building materials, etc.), which are characterized by essential differences in levels of outlays by regions as affected by natural-climatic and economic-geographical conditions, wholesale prices are based on costs for individual production regions (zones).

In construction the methods of setting prices for output are substantially different from the methods which have been adopted in most of the branches of material production. The indicated differences are conditioned by the place of construction within the system of the branches of material production and its role in the process of extended reproduction, as indicated by Marx. "Part of the means of labor, also including the general conditions of labor, is either attached to a definite place, when this part as means of labor enters into the production process, or when it is prepared to carry out a production function, as, for example, that of a machine. Alternatively, this part of the means of labor from the very beginning is produced in such an immovable form, linked with a definite place, as, for example, soil improvement, factory buildings, blast furnaces, canals, railroads, etc. In this case the constant attachment of the means of labor to the production process in which they must function is, at one and the same time, conditioned by the physical mode of their existence."[1]

The output of construction consists of buildings and structures which, in turn, become means of labor (capital assets utilized for production or nonproduction purposes) within the process of extended reproduction. The process of creating capital assets, begun in the branches of heavy industry, is completed here, assuring the realization of the technological unity of the positive and negative portions of the capital assets as well as their economic merger.

Buildings and structures which have been prepared for use constitute the product of production based on the cooperation and specialization of numerous organizations. The leading role in this production is played by the construction organization--the general contractor. The objective of computations between the customer (buyer) and the general contractor is to ascertain the cost of construction output in that portion whose expenses are borne by the contracting organizations, i.e., construction and assembling operations.

Thus, under the existing organizational forms and economic methods of construction management only a portion of construction output is implemented in commercial form, namely the construction and assembling operations, the outlays for which comprise the cost of the negative portion of capital assets for production and nonproduction purposes. The outlays which comprise the cost of the capital assets (construction and assembling operations, outlays for obtaining equipment, etc.) are computed by the customer and are transferred by him without charge from his own account to the account of the user organization.

During the last few years the technological structure of capital investments in most branches has been characterized by the following progressive shifts: a growth in that portion of investments utilized for the acquisition of equipment and machinery, while the portion of investments in construction and assembling operations is being curtailed. In most branches, however, construction and assembling operations occupy an important place in the makeup of capital investments. Therefore, to a considerable extent, their appraisal on a reliable, economically grounded basis effects a correct determination of the cost of the national economy's capital assets, a balanced quality of capital investments, material resources, and production capacities, as well as an assurance of normal economic cost accounting by the contracting organizations, and, in the final analysis, an increased effectiveness in capital investments.

The role of the price of construction output is carried out by the estimated cost of construction and assembling operations. This situation is shared by the majority of scholarly economists. Nevertheless, with regard to the question of computation in prices for ONZT [expansion unknown] construction output and with regard to the ratio of individual and socially necessary labor expenditures in the formation of these prices various different opinions, at times contradictory ones, have been expressed. There has been a widespread acceptance of the viewpoint in accordance with which price formation in construction is based on the general principles which are inherent to all the branches of material production and primarily in ONZT price computations for the production of construction output. Along with this in many operations there is an emphasis on the individual character of determining prices for construction output, which are usually linked with the technical and economic properties of the branch. For example, a formulation such as the following is cited: "...The cost (price) of final construction output is distinct for each overall construction, and this is essentially different from an industry wherein standardized wholesale prices are utilized for the entire country or for its individual economic regions."[2]

Consequently, the price of construction output is regarded as a category which, on the one hand, reflects socially necessary labor requirements and which, on the other hand, takes into consideration individual outlays as applied to the conditions of a specific construction project. Obviously, the above-indicated characteristics of the methods of price formation in construction, as cited in their most general aspect, are mutually exclusive. But what then is the genuinely economic nature of outlays which are reflected in the prices for construction output: are they socially necessary (average for the branch, zone, etc.) or are they individually distinct in their nature?

In order to elucidate this, let us consider the formula for determining the price of construction output, which may be represented in the following form:

$$Ц_п = \left(\sum_{1}^{n} O_i C_i\right) K_н K_р Л,$$

where $Ц_п$ is the price of construction output; O_i represents the volumes (quantity) of construction elements and the forms of operations which are envisaged by the plan for the building (structure) for the conditons of region i in measurements of standardized computations, estimated prices, and other norms; C_i represent the normative (estimated) outlays per unit of construction element (type of operation) in accordance with a standardized computation, estimated price, etc., as operative in region i; $K_н$ represents the coefficient of overhead expenses, as determined by the formula $1 + \frac{H}{100}$, where H is the norm of overhead expenses, as established in percentages of direct outlays; $K_р$ represents the coefficienct of planned accumulations (normative profit), as determined by the formula $1 + \frac{P}{100}$, where P is the norm of planned accumulations, as established in percentages, $Л$ represents the coefficient of limited outlays (expenditures for the construction of temporary buildings and structures, additional expenditures connected with the production of operations during wintertime, and others).

The basis of the price of construction output is composed of the following two elements: the volumes (quantity) of construction elements and types of operations envisaged by the plan for the building (structure) and the magnitudes of the normative (estimated) outlays per unit of the construction element (type of operations).

The individual nature of the price of construction output is linked primarily with the reflection therein of the volumes of operations which are conditioned by the engineering, construction, and volume-planning solutions for the buildings (structures).[3]

At the same time, to the degree in which the price of construction output is determined by the magnitude of estimated norms and standardized computations, as well as that of estimated prices for materials and other norms which are utilized to estimate the planned volumes of operations, it reflects the socially necessary labor outlays. Such an approach permits us to discover the most characteristic traits of the methods of price formation in construction, the general and the particular in the mechanism of determining prices for construction output in comparison with other branches of material production.

The specifics of price formation in this branch consists of the fact that the bearer of the ONZT in the price of construction output is its estimated normative basis, i.e., the estimated norms and standardized computations, estimated prices for materials, and other estimated norms. They determine the scope of the socially necessary labor outlays to cover the means of production dispersed in the construction process and to pay for manpower per unit of structural element (type of operations), while in the utilization of standardized plans--per unit of final construction output.[4]

The system of generally mandatory estimated norms and prices which is used to calculate the estimated cost of construction includes a great number of different norms, providing for unequal territorial differentiation and incongruent regions of operation, which reflects the characteristics of ONZT formation for the various respective types of resources.

Within the present-day scope of social production, the considerable complication of its branch structure, and the extension of the geography of capital investments, linked primarily with the inclusion of the regions of Siberia and the Far East in economic circulation, an important prerequisite for improving the quality of planning capital investments is the creation of a system of general cost indicators which would reflect equivalent volumes of construction (construction and assembling operations) in various different regions of the country.

In order to make the transition from interregional comparisons of estimated prices on individual types of materials, standardized calculations on the structural elements of buildings and types of operations, etc. to a comparative appraisal of the regional level of the estimated cost of construction, it is necessary to "weigh" the numerous estimated norms with the volumes which characterize the construction, architectural-planning, and engineering solutions of the various types of buildings and structures. For these purposes use has been made of a set of material-technical and labor resources, containing proportionate indicators of their outlays and characterizing in an averaged-out form the model of the building (structure) with the specified technical parameters. The calculations which have been carried out in accord-nce with such a model have permitted the "integration" of numerous types of estimated norms, adopted for determining the estimated cost of construction. Such a device has ensured, on the one hand, a consideration of the specific traits of the formation of the social level of outlays for each individually taken form of objects and tools of labor which are utilized in the process of creating construction output and, on the other hand, an appraisal of the level of outlays in the aggregate, i.e., in that form in which they genuinely reflect the cost structure of construction output. The influence of price-forming factors on the regional level of estimated cost of construction should be considered, in our opinion, in the following two basic aspects: the first characterizes the differences in the levels of estimated norms and prices by regions within a constant natural-substantive structure of construction output; the second is linked with an appraisal of the variations in the levels of estimated norms and prices by regions in conjunction with differences in the composition of material-technical and labor resources, reflecting the planning and engineering (branch) characteristics of construction.

Study of the former aspect allows a determination to be made of the measure of differences in the level of estimated norms by regions "in a pure form" (differences in the wholesale prices for building materials, items, and structural components, rates for freight hauls, conditions and distances for transporting materials to construction sites, wage rates for workers, norms for overhead expenses, etc.). Moreover, the influence of all other factors except for those of price formation are eliminated (branch characteristics, natural-climatic conditions of the regions, etc.). In order to characterize the above-mentioned differences, norms were determined, and they came to be designated as "territorial indicators of the estimated cost of construction and assembling operations by regions of the country."

The second aspect allows us to establish the nature and measure of regional changes in the level of estimated norms and prices when they are utilized in various combinations, reflecting the proportionate outlay of material-technical and labor resources with regard to branches taken separately (subbranches), as well as the natural-climatic conditions of regions and zones. It was for this purpose that magnitudes were determined of the branch coefficients for changing the estimated cost of construction and assembling operations in accordance with the regions of the

USSR. They contain normative appraisals of the regional level of estimated outlays for oblasts, krays, and republics (in relationship to the base region--Moscow Oblast) for approximately 70 branches and subbranches of the national economy and industry. Each of the above-mentioned aspects, despite their obvious interconnection, is of independent importance, reflecting the various forms of direct and reciprocal ties of the estimated norms and the planning and engineering solutions which affect the regional level of the estimated cost of construction.

Experimental computations have shown that in order to obtain enlarged quantitative appraisals characterizing the correlations in the level of costs by regions sets may be utilized which contain a modest number of representative resources instead of a fully developed list of them, including more than 160 types and varieties of resources. Computer calculations using a specially worked-out program have allowed us to derive sets for use in an expedited analysis of the regional level of the estimated costs of construction and assembling operations. Thus, for industrial construction the set contains 14 representative resources, while for agricultural production construction it contains 11. An appraisal of the representative resources in estimated prices of each oblast, kray, autonomous and Union republic testifies to the fact that the results of calculations differ only insignificantly from the magnitudes of territorial indicators computed on the basis of utilizing a complete list of material-technical and labor resources.

An analysis of the magnitudes of territorial indicators by economic regions has allowed us to obtain the following results. In industrial construction the territorial indicators of six economic regions (Central, Volgo-Vyatka, Volga, Southern, Trans-Caucasian, and Moldavian SSR) are close to the base region's indicators and differ from them by no more than 1--2 percent. A second group of economic regions (Donets-Dnieper, Southwestern, Baltic, Belorussian) is characterized by a lower level (by 3--5 percent) of estimated costs for construction and assembling operations as compared with the level of the base region. A third group of economic regions (northwestern, Central-Chernozem, North Caucasian, Urals) exhibits the same scope of deviations in the level of estimated costs (3--5 percent), but in the direction of being higher as compared with the base region. A fourth group comprises economic regions in which the level of estimated costs substantially exceeds the level of the base region (by 7--9 percent). This group includes the Central Asian, Western Siberian, and Kazakhstan regions. In two economic regions the level of the estimated cost of construction and assembling operations is considerably higher than that of the base region: in Eastern Siberia by 14 percent and in the Far East by 36 percent.

In agricultural construction the regional level of the estimated costs of construction and assembling operations is characterized by indicators whose magnitudes differ substantially from the indicators of industrial construction. Except for the Baltic region (with a territorial indicator of 0.99) agricultural construction has not a single economic region in which the level of estimated norms and prices is lower than the level of the base region. Only two economic regions have indicators which are equal to the indicators of the base region (the Southwestern and the Moldavian SSR). In three economic regions (the Belorussian, Donets-Dnieper, and Central) the level of the estimated costs of construction and assembling operations is 4--5 percent higher than the level of the base region.

The level of the estimated costs of construction in the remaining economic regions substantially exceeds the level of the base region: in three regions (the Southern, Northwestern, and Trans-Caucasian) by 6--9 percent, in six regions (Volgo-Vyatka, Central-Chernozem, Volga, North-Caucasian, Urals, and Central Asian) by 11--16 percent, in the Western Siberian by 21 percent, in the Eastern Siberian by 27 percent, in Kazakhstan by 32 percent, and finally, in the Far East by 40 percent. The data cited characterize the regional level of estimated norms and prices for territories within the bounds of which unified regional standardized calculations (ERER-69) are utilized to determine the estimated costs of construction and assembling operations.

As regards estimated norms and prices in the regions of the Far North and in localities equivalent to them, they are considerably higher than in the country's remaining territory. These norms and prices reflect the traits of the development and distribution of the material-technical base of construction in the regions indicated, the conditions of transport delivery to construction sites, natural-climatic characteristics and a number of other factors which, in the final analysis, are reflected in the structure and the level of the estimated costs of construction. Thus, in Magadanskaya Oblast they amount to from 250--300 percent in the central group of regions to 400--470 percent in the northern group of regions; in the Yakutskaya ASSR--from 240--280 percent in the central group of regions to 750--770 percent in the northwestern and northeastern regions of the republic (the level of estimated norms and prices in Moscow Oblast is taken as 100 percent).

Depending on the nature and dimensions of the intraregional variations in the level of estimated norms and prices by oblasts, krays and republics which are included in the economic regions, the latter may be grouped in the following manner.

Group I includes the economic regions which are characterized by insignificant variations in the level of estimated norms by oblasts, krays and republics (Donetsk-Dnieper, Southern, Trans-Caucasian, and certain others). In the regions indicated, the span of dimensional variations in the territorial indicators by oblasts, krays and republics does not exceed 3--5 percent, as a result of which each of these economic regions may be considered as a unified whole within an enlarged appraisal of the level of estimated norms and prices.

Group II includes economic regions in which the extremal values of the intraregional variations in the level of estimated norms are characterized by significantly large magnitudes. Moreover, the principal portion of the oblasts, krays and republics which are included within a region comprises a "bloc" with an equal or approximately equal level of estimated norms and prices, while deviations from the indicated level are observed only in one or a few oblasts (Volga-Vyatka and certain other regions).

Finally, Group III includes a majority of the economic regions with an extremely uneven distribution of the magnitudes of territorial indicators by oblasts, krays and republics. A tendency characterizing an average level of estimated norms for the economic region is manifested by means of constant and at times significant variations in the indicators which reflect the level of estimated norms and prices by oblasts, krays and republics. Therefore, in working out and implementing planned, projected, and economic solutions the average appraisal of the level of estimated norms and prices by economic region may turn out to be unreliable.[5]

A comparative analysis of the magnitudes of branch coefficients (for subbranches included as part of a branch as well as between branches) and a comparison of them with territorial indicators has allowed us to discover definite principles in the formation of their levels. A general tendency for a change in the estimated costs of construction and assembling operations in a cross-section of economic regions, which was reflected in the territorial indicators, has been manifested in an overwhelming majority of branches. Many branches are characterized by a close coordination or insignificant deviations in the magnitudes of branch coefficients by oblasts, krays and republics among themselves as well as in comparison with the characteristics of the territorial indicators.

Significant deviations (more than 3--5 percent) in the magnitudes of coefficients by subbranches which are part of a branch as well as among branches occur in the presence of one of the following conditions or a combination of them: in cases where the structure of material resources in the branch is characterized by a distinctly expressed specific trait, particularly in connection with a primary need for one (or several) types of resources (for example, the use of pipes in the subbranch "Transport of Petroleum and Petroleum Products," rails and ties in the subbranch "Railroad Transport," cable products in the "Communications" branch, and so forth); when use is made, in order to determine the estimated costs of construction, of departmental catalogs of estimated prices for local materials, items and structural components (electric power engineering, water maintenance, railroad transport, and a number of other branches) instead of oblast catalogs for zonal estimated prices which are utilized for comparing estimated documentation in most branches.

In characterizing the regional level of the estimated costs of construction, the territorial indicators and branch coefficients, by supplementing each other, reflect various aspects of the multi-form economic-geographical and natural-climatic conditions of the regions. This determines their importance and the value of their utilization in carrying out technical-economic calculations, based on an enlarged appraisal of the levels of estimated costs of construction by oblasts, krays, autonomous and Union republics, and economic regions.

Calculations show that it is efficient to utilize the branch coefficients for the branches as a whole, without breaking them up into subbranches, with the exception of those which have substantial differences in their levels, conditioned by objective factors. In industry, for example, such branches include ferrous metallurgy (the coefficients are established separately for the mining and enriching of raw materials and for ferrous metallurgy not counting the mining and enriching of coal); nonferrous metallurgy (the coefficients are determined separately for quarries and cuts, facilities with shaft surfaces, and others); electric power engineering (the coefficients are established separately for hydroelectric power stations, GRES's((State regional electric power stations)), thermal electric power stations, electric networks, etc.), and a number of other branches.

The creation of a developed system of normative regional indicators has permitted a transition to a qualitatively new stage of resolving this economic problem--the regionalization of the country's territory by the level of the estimated costs of construction (to characterize this the term "estimated regionalization" has been proposed). Regionalization, as is the case with any kind of classification, constitutes a definite abstraction which permits, on the basis of summing up derived information from a large number of indicators with diverse characteristics, the discovery in them of that which is most essential. As a result, it has become possible to utilize for the purpose of solving economic problems a comparatively small number of indicators in groups, and this substantially improves the qualitative base of the information being used. Estimated regionalization is marked by a great deal of complexity, dynamism, and inertia at the same time, as well as by an indefiniteness and inexactness of the derived information. The process of regionalization proposes a grouping of territorial units such that minimal deviations (in accordance with a fixed criterion) in the respective characteristics of territories included within the region are answered.

The regionalization of the country's territory by the level of the estimated cost of construction is a major step on the road to creating a "price atlas of construction" which should reflect the complex and reciprocal economic ties, "refracted" through the prism of regional differences in the levels of capital investments in construction and assembling operations.

Distinctions must be made between the following: general branch regionalization, which reflects regional differences in the levels of estimated norms and prices (without a "tether" to specific branches of the national economy and industry) as compared with regionalization by branches (groups of branches) of the national economy and undustry, which is based on an enlarged appraisal of the regional differences in levels of estimated costs with consideration being given to the branch specifics of construction. Each of the above-mentioned types of regionalization possesses a relative originality and independence and reflects a definite aspect of the economic-geographical conditions of the regions and zones.

One price region comprises oblasts, krays, autonomous and Union republics (those not having oblast division) in which the levels of estimated costs deviate within the limits of a given interval. In forming the price regions use was made of the index of the 80th series of preferable numbers (with deviations not exceeding 3 percent).[6] Calculations show that further narrowing of the range of variations of the above-indicated magnitudes (less than 3 percent) is economically inefficient because of the nature and scales of the averaging out of the derived information.

The question arises: wherein lies the advantage of utilizing the system of estimated regionalization in comparison with the use of the territorial indicators which have been worked out for the separate oblasts, krays and republics? As was noted above, under the estimated regionalization the territorial indicators are generalized. As a result regions are created with quantitative characteristics which are close to the level of estimated norms. These price regions reflect more exactly the dominant tendencies in the formation of the spatial structure of the estimated costs of construction in comparison with the separate oblasts, krays and republics, while their quantitative characteristics are quite constant and stable. In the formation of the price regions territorially adjacent oblasts, krays and republics were defined, in which the above-mentioned indicators are characterized by "troughs" or "peaks" in comparison with the bloc of surrounding oblasts. The formation of price regions has allowed us to discover--in the form of "feedbacks"--the causes of the indicated "breakdowns" in the individual oblasts and republics as well as to evaluate measures by which to put them on an economic footing. Consequently, the creation of a system of estimated regionalization constitutes a process of forming regions with a normalized spatial structure of the estimated costs of construction, and this is of primary importance in providing the ground work for an evaluation of capital assets and for a solution to the economic problems of planning capital investments and managing construction.

As a result of general branch regionalization of the country's territory 16 regions and subregions have been formed in industrial and civil construction and eight in agricultural construction. Thus, the first price region (with a range of territorial indicators of 0.94--0.97) encompasses 32 territorial units, including two Union republics (the Latvian SSR and the Lithuanian SSR), all six oblasts of the Belorussian economic region, eight of the Donetsk-Dnieper economic region, 14 of the Southwestern economic region, as well as the Kalinin (Central economic region) and Volgograd (Volta economic region) oblasts.

A special place within the system of the general branch estimated regionalization is occupied by the so-called "macroregionalization," which envisages the formation of price regions with the utilization as basic magnitudes the territorial indicators, as determined for the economic regions on the whole, without their division into oblasts, krays and republics. As the criterion here for the formation of price regions the indicator of the 40th series of preferable numbers has been adopted (with deviations in territorial indicators of 6 percent). There are 9 price regions of this type in industrial and civil construction and 5 in agricultural construction. The less differentiated system of basic indicators which marks macroregionalization allows us in a delimited sense to abstract from quantitative characteristics the levels of estimated norms as oriented toward the primary territorial units--the oblasts, krays, autonomous republics and the Union republics which are not divided into oblasts. One of the advantages of macroregionalization is the stability of the system in time, and this is particularly important in prognosis-type technical and economic calculations and in future planning.

As distinct from the general branch system, regionalization by branches of the national economy and industry takes into account the regional characteristics of the planning and technological structure of construction and the conditions of the estimated setting of norms by branches. It must be borne in mind that the combination of the above-mentioned characteristics and conditions in many branches is specific; it reflects the level of their technical development as well as the forms and methods which have taken shape in order to determine prices for construction output. Nevertheless, the formation of price regions for the complete set of branches, as envisaged in the national economic plan, though creating an illusion of reliability, actually leads to a decrease in the stability of the economic parameters which characterize the regional level of the estimated cost of construction.

The results of studies which have been carried out testify to the feasibility of merging branches for the above-mentioned purposes by the following groups: the gas industry; the petroleum-extracting industry; the transport of petroleum and petroleum products; hydroelectric power stations, electric power networks, the lumbering industry, the remaining branches of industry; agriculture; water management; forestry; railroad transport; housing, cultural, and personal construction.

The forms of the territorial organization of the national economy are constantly being improved. Characteristic in this regard is the development of such basically new forms as the territorial-production complexes (TPC's). Planning practice during the last few years has provided for the purposeful apportionment of resources for the country's individual territories whose development presents a problem of All-Union importance. In connection with this an important role is being played by purposeful territorial regionalization by level of estimated cost of construction, presupposing the working out of a system of indicators, oriented at such a type of individual zones. For this purpose use is made of the branch coefficients of the changes in the estimated costs of construction and assembling operations, which are combined for individual zones and the TPC's.

The basic principles determining the methods of estimated regionalization and the possibilities for its functional use amount to the following: estimated regionalization has an objective economic basis, and it characterizes the spatial differences of the levels of estimated costs of construction to the degree in which these differences reflect in an averaged-out form (by means of a system of generally mandatory estimated norms) the typological conditions for forming the social costs of construction output, as determined in the final analysis by the structure of the economy, by the rate and level of its development, by the presence of capital assets and production capacities, by the level of labor productivity, the profitability of production, etc.

The system of estimated regionalization takes into consideration the possibilities of substantial differences in the degree of combining basic indicators. This is connected, in the first place, with the traits of organizing spatial forms within the bounds of which are established and changed the conditions of applying living and past labor in construction as well as in the branches which provide it with material-technical resources and services; in the second place, with differences in the functional use of the economic characteristics of corresponding regions (division into general-branch regionalization and regionalization by branches of the national economy, etc.).

In order to obtain an economic characterization of the regions, one must utilize the nomenclature of indicators, which encompasses various aspects of the regional cost estimate of construction (in comparison with the base region --Moscow oblast): the total indicator--the "level of the estimated costs of construction and assembling operations"; groups of coefficients which characterize regional differences in the level of estimated outlays (materials, the basic wages of workers, the operation of construction machinery, and overhead expenses), in the level of estimated prices for free-object warehouse construction materials by consolidated groups of materials; in the level of elements comprising the estimated price (wholesale prices and transport-handling expenses) by consolidated groups of materials.

The economic characteristics of the regions should be comparable, i.e., the quantitative criteria which are used to delineate regions of a given type must be identical. In regionalization (except for macroregionalization) one must ensure the comparison of economic characteristics of a given region with All-Union characteristics as well as with those for other regions, especially those located on adjacent (bordering) territories. This is all the more important inasmuch as in reality there occur not abrupt, spasmodic changes but rather gradual changes in the conditions of forming estimated costs of construction among regions.

Estimated regionalization is oriented toward projects which have been accepted in territorial planning. Working out the indicators which contain the cost characteristics of territories within a system of estimated regionalization fills in an essential gap in creating the normative base which is necessary to work out and implement planned, project, and economic solutions. Its adoption should facilitate the improvement of the forms and methods of territorial planning; it will allow the optimization of branch and territorial schemes for the development and distribution of production forces and enable us to find more effective solutions in many instances. Estimated regionalization, which reflects the systematized price characteristics of regions, may be utilized to solve various classes of economic problems as follows: the termination of plan (forecast) indicators--for providing grounds for the volumes and structure of construction output, the determination of production capacities of construction organizations and needs for material-technical resources, providing grounds for the economic indicators of a branch; selecting optimal production variants--in analyzing and appraising the comparative economic effectiveness of capital investments, etc.; forming a normative base which is used in planning and at the preplanning stage of development; managing and organizing construction production--in analyzing economic indicators and evaluating the completion of the plan by territorial construction organizations, defining the categorical indicators of combines, SMU's, etc.; problems of improving the setting of estimated norms and other functional problems in the branch.

Estimated regionalization reflects the actual level of estimated norms and prices, as well as the territorial division of labor which has taken shape on a nationwide level. Shifts in the distribution of material production and the development of Union republics and economic regions are leading to changes in the territorial proportions of the national economy. Nevertheless, estimated regionalization, particularly macroregionalization, will not be modified essentially in the future (until 1990) since the shifts which have taken place in proportions have occurred very slowly. It is true that serious changes have been undergone by the cost characteristics of a number of regions in Kazakhstan, Siberia, the Far East, on the territories of which radical transformations have taken place, directed at drawing natural resources into economic circulation and winning new territories.

The above-mentioned changes will occur under the influence of two basic groups of factors which are operating at cross purposes as follows: on the one hand, lowering the level of expenses and prices as these regions .. .on, regions which are characterized by a great concentration of resources, a development of the production base, and the creation of a modern infrastructure; on the other hand, raising the level of prices and rates for the purposes of stimulating the expansion of the scales of production and attracting additional manpower. In estimated regionalization for the future more and more impetus will be placed on the trend towards gradually bringing closer together the levels of the estimated norms and prices by major regions as integration processes develop in the national economy and the levels of the economic development of oblasts, krays and autonomous and Union republics become more even.

FOOTNOTES

1. K. Marx and F. Engels, "Soch." [Works], Vol 24, p 182.

2. "Teoriya i metodologiya planovogo tsenoobrazovaniya "[Theory and Methodology of Planned Price Formation], Izd. "Mysl'", 1976, p 260.

3. It should be borne in mind that in determining the planned volumes of operations we are guided by the norms of engineering and construction planning, which take into account the level achieved in the standardization of buildings, facilities, structures and equipment, i.e., they reflect the socially necessary conditions of production. However, the volumes of operations to be carried out in erecting buildings and structures are established in each specific instance with consideration being given to the functional purpose of the project, as well as the natural-climatic and economic-geographical conditions of the region of construction, i.e., individually.

4. The question of establishing norms for the magnitude of net income in the price of construction output is not regarded here as one of independent importance.

5. For this same reason the utilization in norms of proportionate capital investments by a number of branch indicators, which envisages the division of the country's territory into 10-12 zones, leads to a substantial distortion in the appraisal of the regional level of the estimated costs of construction and assembling operations.

6. Series of preferred numbers are used in establishing gradations of parameters and dimensions as well as individual numerical characteristics in technology. They consist of decimal series of a geometric progression with denominators (80th series is $\sqrt[80]{10 \quad 1.03}$).

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CONSTRUCTION, CONSTRUCTION MACHINERY, AND BUILDING MATERIALS

STANDARDIZED MEMBERS FOR 1-STORY INDUSTRIAL BUILDINGS NOTED

Moscow VOZVEDENIYE ODNOETAZHNYKH PROMYSHLENNYKH ZDANIY UNIFITSIROVANNYKH GABARITNYKH SKHEM in Russian 1978 pp 4-12

[Chapter 1 of the book, "Vozvedeniye odnoetazhnykh promyshlennykh zdaniy unifitsirovannykh gabaritnykh skhema"[The Erection of One-Story Industrial Buildings of Standardized Dimensioning Schemes], 2d Edition, revised and supplemented, by the Scientific-Research and Experimental Design Institute for the Organization, Mechanization and Technical Assistance to Construction (TsNIIOMTP), Stroyizdat]

[Text] 1. Characteristics of Three Dimensional Layout and Structural Solutions of Buildings

The three-dimensional layout and structural solutions of one-story industrial buildings are the most important features that determine the principles for the organization and technology of their construction. The three-dimensional layout solutions determine: the configuration, layout, area, height, structural volume, columnar network, and the number, sizes and placement of bays; and the structural solutions determine the choice of load-bearing and curtain-wall structure, the analysis scheme, the types and sizes of structural members and their joining, materials, and so on.

In accordance with the three-dimensional layout solution, industrial buildings can be categorized as one-bay, two-bay and multibay. The most common cases are multibay buildings, whose configuration enables a whole set of production operation processes to be accomplished inside the building.

The sizes of the bays and their mutual placement are determined by the operating processes of the given production work. More often than not, identical bays of a building are located parallel to one another. In some cases a block of bays placed in parallel is joined to a bay placed perpendicularly.

One-story industrial buildings are subdivided in accordance with not only their three-dimensional layout characteristics but also the lifting and transporting equipment used, into buildings without cranes and buildings equipped with overhead-traveling bridge cranes. In the first case, transport operations inside the building are performed by floor transport and beam-mounted overhead-traveling hoists attached to the building's load-bearing roof structure. In the second case—by means of overhead-traveling bridge cranes or by beam-mounted overhead-traveling hoists that move over crane tracks laid on crane beams, which rest on the columns. In multibay buildings, combinations of the types of transport equipment named are used.

Depending upon the type of covering, buildings have sloped (one-slope or two-slope) or flat roofs. Single-bay buildings, as a rule, are designed with sloped roofs, multibay buildings with both sloped and flat roofs.

In order to insure ventilation of and natural light for the premises in certain types of industrial buildings, the installation of skylights is stipulated. Skylights are arranged longitudinally (along the bay of the building) or laterally. Roofs with longitudinal placement of metal skylights are most widely used. Multibay buildings can have some bays with skylights and some bays without them.

In current industrial construction practice, about 30 percent of all buildings are erected without skylights. Such buildings are ventilated by air conditioning systems and afforded constant illumination in the absence of windows by daylight-type bulbs.

Depending upon the technological peculiarities of the main production work of the enterprises that are being built, single-story buildings can be heated or unheated, with a suspended ceiling or without one.

In certain cases, for operating needs, basements are built in industrial buildings in which technological equipment, pipelines and so on are placed.

Premises for the amenities and premises for special services for an enterprise's departments are placed in buildings that abut on the main building at the main facade or on the ends, or inside the building (built-in premises). Sometimes these premises are situated in a separate building.

Three-dimensional layout solutions for one-story industrial buildings of unified dimensioning schemes with reinforced-concrete frame are shown in table 1.

Industrial buildings with standardized dimensioning schemes with bays of 30 and 36 meters are solved with steel roof trusses and are characterized by the following parameters:

Buildings without cranes—height from 6 to 18 meters; and spacing of perimeter columns 6 meters and of center columns 6 or 12 meters; and

Buildings equipped with supporting overhead-traveling bridge cranes—height from 10.8 to 18 meters; and spacing of perimeter columns 6 or 12 meters and center columns 12 meters.

List of Building Blocks for Single-Bay and Multiple-Bay One-Story Industrial Buildings of Unified Dimensioning Schemes (with Prefabricated Reinforced-Concrete Frames)

Table 1

(1) Условный номер ячейки	(2) Шифр габаритной схемы	(3) Высота до низа стропильных конструкций, м
(4) **А. Здания без подвесного или с подвесным подъемно-транспортным оборудованием грузоподъемностью до 5 т**		
(6) *Пролет 6 м*		
1	Б-6-30а	3
2	Б-6-36а	3,6
3	Б-6-42а	4,2
4	Б-6-48а	4,8
5	Б-6-54а	5,4
6	Б-6-60а	6
Пролет 9 м		
7	Б-9-30а	3
8	Б-9-36а	3,6
9	Б-9-42а	4,2
10	Б-9-48а	4,8
11	Б-9-54а	5,4
12	Б-9-60а	6
Пролет 12 м		
13	Б-12-30а	3
14	Б-12-36а	3,6
15	Б-12-42а	4,2
16	Б-12-48а	4,8
17	Б-12-54а	5,4
18	Б-12-60а	6
19	Б-12-72а	7,2
20	Б-12-84а	8,4
21	Б-12-96а	9,6
Пролет 18 м		
22	Б-18-48а	4,8
23	Б-18-48б	4,8
24	Б-18-48в	4,8
25	Б-18-48г	4,8
26	Б-18-60а	6
27	Б-18-60б	6
28	Б-18-60в	6
29	Б-18-60г	6
30	Б-18-72а	7,2
31	Б-18-72б	7,2
32	Б-18-72в	7,2
33	Б-18-72г	7,2
34	Б-18-84а	8,4
35	Б-18-84б	8,4
36	Б-18-84в	8,4
37	Б-18-84г	8,4
38	Б-18-96а	9,6
39	Б-18-96б	9,6
40	Б-18-96в	9,6
41	Б-18-96г	9,6
42	Б-18-108а	10,8
43	Б-18-108б	10,8
44	Б-18-108в	10,8
45	Б-18-108г	10,8
46	Б-18-120б	12
47	Б-18-120в	12
48	Б-18-120г	12
Пролет 24 м		
49	Б-24-48а	4,8
50	Б-24-48б	4,8
51	Б-24-48в	4,8
52	Б-24-48г	4,8
53	Б-24-60а	6
54	Б-24-60б	6
55	Б-24-60в	6
56	Б-24-60г	6
57	Б-24-72а	7,2
58	Б-24-72б	7,2
59	Б-24-72в	7,2
60	Б-24-72г	7,2
61	Б-24-84а	8,4
62	Б-24-84б	8,4
63	Б-24-84в	8,4
64	Б-24-84г	8,4
65	Б-24-96а	9,6
66	Б-24-96б	9,6
67	Б-24-96в	9,6
68	Б-24-96г	9,6
69	Б-24-108а	10,8
70	Б-24-108б	10,8
71	Б-24-108в	10,8
72	Б-24-108г	10,8
73	Б-24-120б	12
74	Б-24-120в	12
75	Б-24-120г	12
76	Б-24-132б	13,2
77	Б-24-132в	13,2
78	Б-24-132г	13,2
79	Б-24-144б	14,4
80	Б-24-144в	14,4
81	Б-24-144г	14,4
(5) **Б. Здания, оборудованные опорными мостовыми кранами грузоподъемностью до 50 т**		
Пролет 18 м		
82	К-18-84а	8,4
83	К-18-84б	8,4
84	К-18-84в	8,4
85	К-18-84г	8,4
86	К-18-96а	9,6
87	К-18-96б	9,6
88	К-18-96в	9,6
89	К-18-96г	9,6
90	К-18-108а	10,8
91	К-18-108б	10,8
92	К-18-108в	10,8
93	К-18-108г	10,8
94	К-18-120б	12
95	К-18-120в	12
96	К-18-120г	12
97	К-18-132б	13,2
98	К-18-132в	13,2
99	К-18-132г	13,2
100	К-18-144б	14,4
101	К-18-144в	14,4
102	К-18-144г	14,4
Пролет 24 м		
103	К-24-84а	8,4
104	К-24-84б	8,4
105	К-24-84в	8,4
106	К-24-84г	8,4
107	К-24-96а	9,6
108	К-24-96б	9,6
109	К-24-96в	9,6
110	К-24-96г	9,6
111	К-24-108а	10,8
112	К-24-108б	10,8
113	К-24-108в	10,8
114	К-24-108г	10,8
115	К-24-120б	12
116	К-24-120в	12
117	К-24-120г	12
118	К-24-132б	13,2
119	К-24-132в	13,2
120	К-24-132г	13,2
121	К-24-144б	14,4
122	К-24-144в	14,4
123	К-24-144г	14,4
124	К-24-156б	15,6
125	К-24-156в	15,6
126	К-24-156г	15,6
127	К-24-168б	16,8
128	К-24-168в	16,8
129	К-24-168г	16,8
130	К-24-180б	18
131	К-24-180в	18
132	К-24-180г	18

[Key on following page]

Key:

1. Assigned number of the building block
2. Code of the dimensioning scheme
3. Height to the bottom of the truss structure
4. A. Buildings without or with lifting and transporting equipment with a load-lifting capacity of up to 5 tons.
5. . Buildings equipped with supporting overhead-traveling bridge cranes with load-lifting capacity of up to 50 tons
6. Bay of 6 meters

Note. Legend: Б--a building without cranes; K--a building equipped with a supporting overhead-traveling bridge crane; a--where the spacing of the perimeter columns is 6 meters, center columns 6 meters, and truss structure 6 meters; б--where the spacing of perimeter columns is 6 meters, center columns 12 meters, and truss structure 6 meters; в--spacing of perimeter columns is 6 meters, center columns 12 meters, and truss structure 12 meters; and г--spacing of perimeter columns is 12 meters, center columns 12 meters, and truss structure 12 meters.

Example: Б--18-72a is a building block of a building without a crane, with a bay of 18 meters, height to the bottom of the truss structure of 7.2 meters, and spacing of perimeter and center columns and truss structure of 6 meters.

The gradation of building heights in increments of 0.6 and 1.2 meters and a large number of standard column sizes enable designers to adopt standardized heights for premises that are close to those required by technological considerations. If these considerations require that the design increase the parameters above those adopted in the standardized dimensioning systems, then the bays and column spacing should be designated in multiples of 6 meters, and the height in multiples of 1.2 meters.

When designing industrial buildings, a minimal number of different standardized dimensioning schemes should be used. Choice of a scheme or combination of schemes should be based upon the rational placement of production facilities and the technological equipment and by special requirements for the interlocking of departments.

For each height to the bottom of the truss structure in a building that is equipped with overhead-traveling bridge cranes, there corresponds only one grade level for the specified crane cantilever top, based upon the prerequisites for placement of the crane of the greatest load-lifting capability (tables 2 and 3).

Table 2

Parameters of One-Story Buildings Equipped with Electrical Overhead-Traveling Bridge Cranes

Key:
1. Height of building to bottom of the truss structure, meters.
2. Load-lifting capability of the crane, tons.
3. Grade level of the head of the crane rail, meters.
4. Bay, meters.
5. Spacing of center columns, meters.

Note: Spacing of perimeter columns is 6 or 12 meters.

Высота здания до низа конструкций покрытия, м	Грузоподъемность крана, т	Отметка верха головки кранового рельса, м	Пролет, м	Шаг средних колонн, м
8,4	10	5,75	18, 24	6, 12
9,6	10, 20	6,95	18, 24	6, 12
10,8	10, 20	8,15	18, 24	6, 12
10,8	10, 20	8,15	30, 36	12
12	10, 20	9,35	18, 24, 30, 36	12
12	30	8,65	18	12
12	30, 50	8,65	21, 30, 36	12
13,2	10, 20	10,55	18, 24, 30, 36	12
13,2	30	9,85	18	12
13,2	30, 50	9,85	24, 30, 36	12
14,4	10, 20	11,75	18, 24	12
14,4	20	11,75	30, 36	12
14,4	30	11,05	18	12
14,4	30, 50	11,05	21, 30, 36	12
15,6	30, 50	12,25	24, 30, 36	12
16,8	30, 50	13,45	24, 30, 36	12
18	30, 50	14,65	21, 30, 36	12

In designing buildings with suspended transport equipment, the truss structure (beams or girders) is designed to be, as a rule, 6 meters. Truss-structure spacing of 12 meters is allowed where standard structure is used. In buildings equipped with overhead-traveling bridge cranes, the 12-meter spacing is accepted.

Table 3

Parameters of One-Story Buildings Equipped with Manually Operated Overhead-Traveling Bridge Cranes

Key:
1. Height of building to bottom of the truss structure, meters.
2. Load-lifting capability of the crane, tons.
3. Grade level of the head of the crane rail, meters.
4. Bay, meters.

Note: Spacing of perimeter and center columns is 6 meters.

Высота здания до низа конструкций покрытий, м	Грузоподъемность крана, т	Отметка верха головки кранового рельса, м	Пролет, м	Высота здания до низа конструкций покрытий, м	Грузоподъемность крана, т	Отметка верха головки кранового рельса, м	Пролет, м
6	3,2; 5; 8	5	9, 12	6,6	3,2; 5; 8	5,6	9, 12
6	5; 8	5	18	6,6	5; 8	5,6	18
7,2	3,2; 5; 8	6,2	9, 12	8,4	3,2; 5; 8	7,4	9, 12
7,2	5; 8	6,2	18	8,4	5; 8	7,4	18
7,2	12,5; 20	5,7	12, 18	8,4	12,5; 20	6,9	12, 18
7,8	3,2; 5; 8	6,8	9, 12	9	12,5; 20	7,5	12, 18
7,8	5; 8	6,8	18	9,6	12,5; 20	8,1	12, 18
7,8	12,5; 20	6,3	12, 18				

In all cases the spacing of perimeter columns is established on the basis of economic considerations, taking into account the structural solution of the roof and wall enclosure, as well as the mastery of the various standard sizes of structural members that are produced by construction-industry plants.

In two-bay buildings less than 7.2 meters high, where perimeter column spacing is 6 meters, it is recommended that the same spacing be used also for the center columns, and, where the height is greater, the use of 6-meter spacing for center columns is permitted only where there is appropriate substantiation for the choice.

With regard to structural solutions, one-story industrial buildings are made up on the basis of frame or nonframe solutions. In frame buildings the basic load-bearing member is the prefabricated reinforced-concrete frame; in nonframe buildings it is the walls that absorb the loads from the roof, lifting and transporting equipment, winds, and so on.

The frame of a one-story industrial building consists of columns that have been fixed to footings, and of crane-beam and truss structure that is fastened to the columns. The columns and truss structure form lateral frameworks. The roof slabs are laid on the truss structure with the welding of embedded parts. Spatial rigidity and stability are achieved in such buildings by fastening the columns to the footings and joining them to the roof. In the lateral direction the building's spatial rigidity is provided by the lateral framework and in the longitudinal direction by the longitudinal framework, roof members, crane beams and tie beams.

Each pair of columns that are situated in the middle of a building or a thermal-expansion unit is joined with tie beams. The length or width of these units can reach 72 or 144 meters in heated and 48 meters in unheated buildings.

When column spacing is 12 meters or more and roof slabs 6 meters long are used, subrafter girders are laid to support the truss structure. When the roof is laid with slabs 12 meters long, the manufacture of which has now been mastered in several parts of the country, the need to use subrafter girders is done away with. This reduces the mix of prefabricated reinforced-concrete items and simplifies the erection of buildings.

Framework columns are installed at the ends of buildings and between two load-bearing perimeter columns of the longitudinal rows with a spacing of 12 meters. They absorb only loads from the wall enclosure and wind forces. In buildings equipped with overhead-traveling bridge cranes, the framework columns of the outer longitudinal rows can be an intermediate support for the crane beams.

Enclosures—roofs and walls—in buildings serve to provide for a normal temperature and moisture regime.

Frame buildings have, as a rule, columnar (anchor-cone) type footings, nonframe buildings have the continuous type.

The footings under the outer columns of the frames of heated buildings and under all the columns of unheated buildings that are erected on soils that heave when they freeze are placed lower than the estimated depth of soil freezing; the depth of soil freezing is not considered in the case of the center columns of the frames of unheated buildings. Large footings are erected under center rows of columns because they absorb much heavier loads than the perimeter walls.

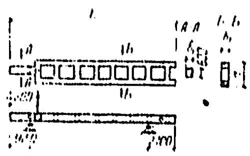
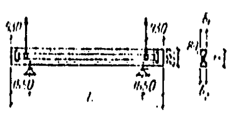
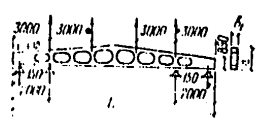
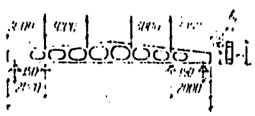
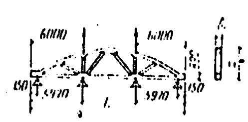
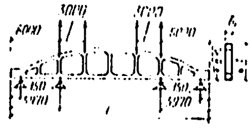
In addition to the above-indicated structure, a number of other prefabricated reinforced-concrete and concrete members are used in one-story production-type buildings: footing and girt beams, partition panels, wall blocks, beams and slabs for suspended ceilings, cornice panels, posts and crossbars of gates, and so on.

Most of the enumerated members have been included in the catalog of standard structure and are being manufactured in accordance with working drawings that are worked out on the basis of the products mix of prefabricated reinforced-concrete structure made at factories for one-story industrial buildings (table 4).

The main prefabricated members that are used in constructing one-story industrial buildings are as follows.

Footings in most cases are made in columnar form, freestanding, or the anchor-cone type. The bottom of the footing can be square, rectangular or

Table 4 (continued)

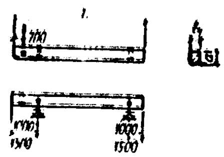
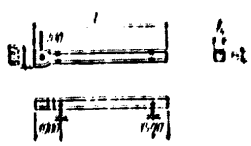
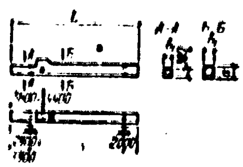
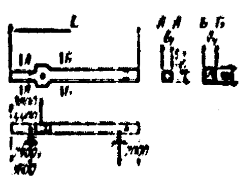
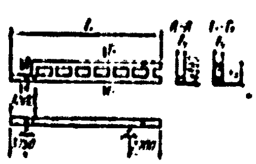
Эскиз (1)	Конструктивные размеры, мм (2): длина l (l_l) (3)	высота сечения h (4)	ширина поверху b_1 (5)	ширина понизу b_2 (6)	расстояние до подкрановой консоли колонны (7)	Масса, т (8)	Серия чертежей и разработчик (9)
при шаге средних колонн 12 м (27)							
	16 950, 18 150, 19 350	1900	500	500	11 850, 13 050, 14 250	19,1—21,1	КЭ-01-51, вып. I, II, III, IV, VI, Проектный институт № 1 (28)
Балки стропильные пролетом 6, 9 и 12 м для односкатных и плоских покрытий зданий при шаге балок 6 м (29)							
	5 960, 8 960, 11 960	590, 890, 890	300, 300, 280	100, 240, 280	—	1,5; 3,4; 5	ПК-01-115, Промстройпроект; 1.462-1, вып. I и II, Промстройпроект (30)
Балки стропильные двускатные, решетчатые пролетами 12 и 18 м при шаге балок 6 м (31)							
	11 960	1390	200	200	—	5,4	1.462-3, вып. I, II, III, Проектный институт № 1 (32)
	17 960	1640	200	200	—	8,5; 10,4; 12,1	То же (33)
Фермы стропильные безраскосные пролетами 18 и 24 м при шаге ферм 6 м (34)							
	17 940	3000	240, 280	240, 280	—	6,5; 7,7; 9,2	1.463-3, вып. I—V, Проектный институт № 1 (35)
	23 940	3300	240, 280	240, 280	—	9,2; 10,5; 11,7; 14,2	То же (33)

[Key on following page]

Key:

1. Sketch.
2. Structural dimensions, mm.
3. Length ℓ (H).
4. Height of cross-section, a.
5. Width of top, b_1.
6. Width of bottom, b_2.
7. Distance to the column's crane cantilever.
8. Weight, tons.
9. Series of drawings and the designer.
27. Where the center column spacing is 12 meters.
28. KE-01-51, Nos I, II, III, IV and VI, Design Institute No 1.
29. Rafter beams with span of 6, 9 and 12 meters for single-slope or flat roofs for buildings where the beam spacing is 6 meters.
30. PK-01-115, Promstroyproyekt; and I-462-1, Nos I and II Promstroyproyekt.
31. Two-slope latticed rafter beams with spans of 12 and 18 meters where beam spacing is 6 meters.
32. I.462-3, Nos I, II and III, Design Institute No 1.
33. Ditto.
34. Rafter girders where there are no cranes, bays are 18 and 24 meters, and girder spacing is 6 meters.
35. I.463-3, Nos I-IV, Design Institute No 1.

Table 4 (continued)

Эскиз (1)	Конструктивные размеры, мм (2)					Масса, т (8)	Серия чертежей и разработчик (9)
	Длина l (H) (3)	Высота сечения a (4)	Ширина поверху b_1 (5)	Ширина понизу b_2 (6)	Расстояние до подкрановой консоли колонны (7)		
Колонны прямоугольного сечения для бескрановых зданий с пролетом 6, 9, 12, 18 и 24 м (17)							
при шаге крайних колонн 6 м (18)							
	3 800—10 500, 15 450	300, 400, 500	300, 400, 500, 600, 700, 800	300, 400, 500, 600, 700, 800	—	0,8—12,2	КЭ-01-49, вып. I, III, V, VII, Промстройпроект (19)
при шаге средних колонн 6 и 12 м (20)							
	3 800—15 450	300, 400, 500	300, 400, 500, 600, 700, 800	300, 400, 500, 600, 700, 800	—	1—12	КЭ-01-49, вып. II—VII, Промстройпроект (21)
Колонны прямоугольного сечения для зданий с пролетами 18 и 24 м, оборудованных мостовыми кранами грузоподъемностью 10 и 20 т (22)							
при шаге крайних колонн 6 и 12 м (23)							
	9 300—15 450	600, 700, 800, 900	400	400	5 700—10 350	5,2—12,5	КЭ-01-49, вып. I, IV, V, VI, Промстройпроект (24)
при шаге средних колонн 6 и 12 м (20)							
	9 450—15 450	600, 700, 800, 900	400	400	5 850—11 550	5,9—12,9	КЭ-01-49, вып. I, IV, V, VI, Промстройпроект (24)
Колонны двухветвевого сечения для зданий с пролетами 18, 24, 30 и 36 м, оборудованных мостовыми кранами грузоподъемностью 30 и 50 т (25)							
при шаге крайних колонн 6 и 12 м (23)							
	16 650, 20 200	1200, 1400	500	500	11 650—15 100	12; 17,4	КЭ-01-52, вып. I, II, III, IV, VI, Проектный институт № 1 (26)

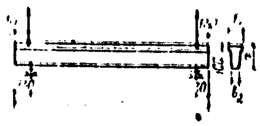
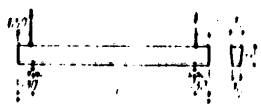
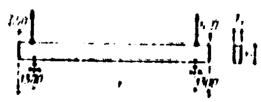
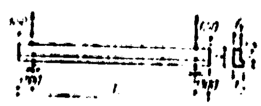
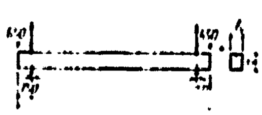
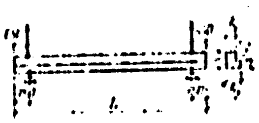
[Key on following page]

Key:

1. Sketch.
2. Structural dimensions, mm.
3. Length ℓ (H).
4. Cross-section height, a.
5. Width of top, b_1.
6. Width of bottom, b_2.
7. Distance to the column's crane cantilever.
8. Weight, tons.
9. Series of drawings and the designer.
17. Columns of rectangular cross-section for buildings without cranes, with bays of 6, 9, 12, 18 and 24 meters.
18. Where the perimeter-column spacing is 6 meters.
19. KE-01-49, Nos II, III, V and VII, Promstroyproyekt.
20. Where the center column spacing is 6 or 12 meters.
21. KE-01-49, Nos II-VII, Promstroyproyekt.
22. Columns of rectangular cross-section for buildings with bays of 18 or 24 meters that are equipped with overhead traveling cranes with load-lifting capability of 10 or 20 tons.
23. Where the perimeter column spacing is 6 or 12 meters.
24. KE-01-49, Nos I, IV, V and VI, Promstroyproyekt.
25. Columns of two-projection cross-section for buildings with bays of 18, 24, 30 or 36 meters that are equipped with overhead-traveling cranes with load-lifting capability of 30 or 50 tons.
26. KE-01-52, Nos I, II, III, IV and VI, Design Institute No 1.

Specifications for Standard Prefabricated Reinforced-Concrete Structure

Table 4

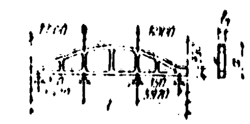
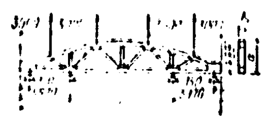
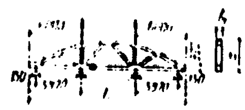
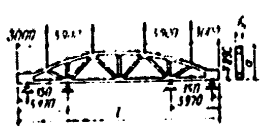
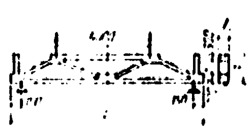
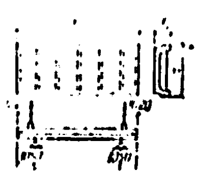
Эскиз (1)	Конструктивные размеры, мм (2)					Масса, т (8)	Серия чертежей и разработчик (9)
	Длина l (l1) (3)	высота сечения h (4)	ширина поверху b (5)	ширина понизу b1 (6)	расстояние до подкрановой консоли колонны (7)		
Балки фундаментные для зданий с шагом колонн 6 м (10)							
	4300—5950	450	400—520	200, 250	—	1,3—2,2	1.415-1, вып. 1, Промстройпроект (11)
	4300—5950	300, 450	200, 260, 300	160, 200	—	0,6—1,6	1.415-1, вып. 1, Промстройпроект (11)
Балки фундаментные для зданий с шагом колонн 12 м (12)							
	10 700, 11 960	400, 600	300, 400	240	—	2,9—5,7	1.415-1, вып. 1, Промстройпроект (11)
Балки обвязочные для стен из кирпича и легкобетонных камней (13)							
	5950	585	200	200	—	1,75	КЭ-01-58, вып. 1, ЦНИИПромзданий (14)
	5950	585	250	380	—	2,5	КЭ-01-58, вып. 1, ЦНИИПромзданий (14)
Перемычки для стен из кирпича и легкобетонных камней (15)							
	3500, 5000	290	200, 250	200, 250	—	0,5—1,1	КЭ-01-58, вып. 2, ЦНИИПромзданий (16)
	3500, 5000	290	250, [illegible]	380, 510	—	0,8—1,6	КЭ-01-58, вып. 2, ЦНИИПромзданий (16)

[Key on following page]

Key:

1. Sketch.
2. Structural dimensions, mm.
3. Length ℓ (H).
4. Cross-section height, a.
5. Width of top, b_1.
6. Width of bottom, b_2.
7. Distance to the column's crane cantilever.
8. Weight, tons.
9. Series of drawings and the designer.
10. Footing beams for buildings with 6-meter column spacing.
11. I.415-1, No 1. Promstroyproyekt [State Institute for General Construction and Sanitary-Engineering Design of Industrial Enterprises].
12. Footing beams for buildings with 12-meter column spacing.
13. Tie beams for walls made of brick or lightweight concrete masonry.
14. KE-01-58, No 1, TsNIIPromzdaniy [Central Scientific-Research and Experimental-Design Institute for Industrial Buildings and Structures].
15. Lintels for walls made of brick or lightweight concrete masonry.
16. KE-01-58, No 2, TsNIIPromzdaniy.

Table 4 (continued)

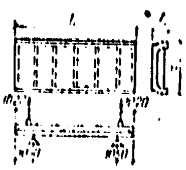
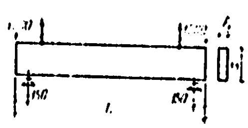
Эскиз (1)	Конструктивные размеры, мм (2)					Масса, т (8)	Серия чертежей и разработчик (9)
	длина l (l_1) (3)	высота сечения h (4)	ширина поверху b_1 (5)	ширина понизу b_2 (6)	расстояние до подкрановой консоли колонны (7)		
Фермы стропильные сегментные пролетом 18 и 24 м при шаге ферм 6 м (36)							
	17 940	2630—2735	200, 250	200, 250	—	4,5; 6; 7,8	ПК-01-129/68, вып. I—III, ЦНИИпромзданий и Проектный институт № 1 (37)
	23 940	3160—3315	250, 300	250, 300	—	9,2; 11,2; 14,9	То же (33)
Фермы стропильные сегментные пролетами 18 и 24 м при шаге ферм 12 м (38)							
	17 940	2735	300	300	—	9,4; 12,2	ПК-01-129/68, вып. II, III, ЦНИИпромзданий и Проектный институт № 1 (39)
	23 940	3315	300	300	—	18,6; 21,3	То же (33)
Фермы подстропильные для зданий со скатной кровлей (40)							
	11 960	2225	550	550	—	11,3	ПК-01-110/68, вып. I, Промстройпроект (41)
Плиты покрытий длиной 6 м и шириной 3 м (42)							
	5970	2980	300	300	—	2,7	1.465-7, вып. 0-5, ЦНИИПромзданий (43)

[Key on following page]

Key:

1. Sketch.
2. Structural dimensions, mm.
3. Length λ (H).
4. Cross-section height, a.
5. Width of top, b_1.
6. Width of bottom, b_2.
7. Distance to the column's crane cantilever.
8. Weight, tons.
9. Series of drawings and the designer.
33. Ditto.
36. Segmental rafter girders with span of 18 and 24 meters where girder spacing is 6 meters.
37. PK-01-129/68, Nos I-III, TsNIIPromzdaniy and Design Institute No 1.
38. Segmental rafter trusses with bays of 18 and 24 meters, where girder spacing is 12 meters.
39. PK-01-129/68, Nos II and III, TsNIIPromzdaniy and Design Institute No 1.
40. Subrafter girders for buildings with sloped roof.
41. PK-01-110/68, No I, Promtroyproyekt.
42. Roof slabs 6 meters long and 3 meters wide.
43. I.465-7, No 0-5, TsNIIPromzdaniy.

Table 4 (continued)

Эскиз (1)	Конструктивные размеры, мм (2)					Масса, т (8)	Серия чертежей и разработчик (9)
	длина l (H) (3)	высота сечения a (4)	ширина поверху b_1 (5)	ширина понизу b_2 (6)	расстояние до подкрановой консоли колонны (7)		
Плиты легкосбрасываемых покрытий длиной 6 м и шириной 3 м (44)							
	5970	2980	300	300	—	1,8	1.465-7, вып. 0-5, ЦНИИПромзданий (43)
Плиты покрытий длиной 12 м и шириной 3 м (45)							
	11 970	2980	455	455	—	7,4—7,8	1.465-3, вып. II, ЦНИИПромзданий (46)
Панели стеновые для зданий с шагом колонн 6 и 12 м (47)							
	5980	900, 1200, 1500, 1800	160, 200, 240, 300	160, 200, 240, 300	—	0,8—1,4	1.432-5, вып. I и II, ЦНИИПромзданий и Уральский Промстройниипроект (48)
	11 980	900, 1200, 1500, 1800	200, 240, 300	200, 240, 300	—	3—7,6	1.432-3, вып. 0-1, ЦНИИПромзданий, НИИЖБ, ЦНИИСФ, НИИСМИ МПСМ СССР (49)

[Key on following page]

Key:

1. Sketch.
2. Structural dimensions, mm.
3. Length ℓ (H).
4. Cross-section height, a.
5. Width of top, b_1.
6. Width of bottom, b_2.
7. Distance to the column's crane cantilever.
8. Weight, tons.
9. Series of drawings and the designer.
43. I.465-7, No 0-5, TsNIIPromzdaniy.
44. Easily expendable roof slabs, 6 meters long and 3 meters wide.
45. Roof slabs 12 meters long and 3 meters wide.
46. I.465-3, No II, TsNIIPromzdaniy.
47. Wall panels for buildings with column spacing of 6 and 12 meters.
48. I-432-5, Nos 1 and II, TsNIIPromzdaniy and Promstroyniiproyekt [All-Union Scientific-Research and Design Institute for Industrial Construction] of the Urals.
49. I.432-3, No 0-I, TsNIIPromzdaniy, NIIZhB [Scientific-Research Institute for Concrete and Reinforced Concrete], NIISF [Scientific-Research Institute for the Physics of Construction], and NIISMI MPSM SSSR [Scientific-Research Institute of Buildings Materials and Articles of USSR Ministry of Construction Materials Industry].

Note: Arrows signify places for slinging prefabricated structure; and triangles show places for resting the prefabricated structure during transport and storage.

stepped, depending upon the cross-section of the columns and the calculated loading.

The dimensions of the anchor cone of a footing are designated with the clearance between its walls and the column: at the bottom it is at least 50 mm, at the top 75 mm. The depth of the anchor cone is at least the greatest dimension of the lateral cross-section of the column and is 800-1,250 mm. At present, columnar foundations are made with a raised anchor-cone piece (grade level above the footing—0.15 meter). This increases somewhat the total cost of the concrete for the footing and the column, but it enables all work on erection of the underground portion of the building to be completed before start of the erection of the above-ground portion.

Columnar footings can be one-piece or built-up. The latter consist of flat slabs for the lower stages and footing blocks with anchor cone. Unification of standard sizes of columnar footings is made difficult by the fact that they can have different laying depths or footing area even for single-story buildings. At present columnar footings of the anchor-cone type are made monolithic more often than not.

Continuous footings are made of two members—reinforced-concrete cushion blocks of trapezoidal or rectangular cross-section and concrete wall blocks. Weight of the cushion blocks is 0.3-3 tons and weight of the wall blocks is 0.15-3 tons. The cushion blocks are laid on a prepared base directly against each other in the form of a strip. The wall blocks are laid on the cushion blocks on mortar with closure of the vertical joints with mortar or a concrete mix. Reinforcement mesh is often laid in the horizontal joints between the first row of wall blocks and the cushion blocks.

In some cases piles are used as a footing under the columns of one-story production-type buildings. The heads of the piles are joined by monolithic or prefabricated reinforced grillage.

Foundation beams are T-shaped or trapezoidal in cross-section. Length of the beams varies from 5.95 to 4.3 meters, depending upon the prerequisites for resting them on the footing cuts or on cripple columns; weight of a beam is 2.2-0.6 tons. Beams 12 meters long are prestressed, and their weight reaches 5.7 tons.

The columns of one-story industrial buildings are of square, rectangular or two-projection cross-section. The columns are without cantilevers—for buildings without cranes, single-cantilever for perimeter rows in buildings with overhead-traveling bridge cranes, and two-cantilever for center rows of multibay buildings with overhead traveling bridge cranes. The under-crane part of the column can consist of one or two projections. At present, structure for an I-beam and circular cross-section column is being developed.

Crane beams for bays of 6 and 12 meters are made with split metal beams, using welded H-beams (series I.426.1, No 1), for general-purpose overhead-traveling bridge cranes with load-lifting capacity of 5-50 tons. For buildings with cranes of 10-30 tons of load-lifting capacity, reinforced-concrete crane beams are used.

In beams for 6-meter bays, unlike beams for 12-meter bays, the installation of braking girders is not called for. The height of beams for 6 meter bays is 800 or 1,300 mm, and for 12-meter bays 1,100 or 1,600 mm, and their weights are, respectively, 0.5-1.36 and 1.37-4.04 tons; the weight of braking girders is within the 0.42-0.67 ton range.

Roof beams for bays of 6 and 9 meters are made lean-to, of T-beam or I-beam cross-section, with straight-line configuration of the upper chord and with plain or latticed web. Height of the beams varies from 600 to 900 mm. These beams are laid without pitch. Beams for 12-meter bays are I-beam in cross-section, and lean-to or double slope. Beams for 18-meter bays are two-slope, I-beam in cross-section, with holes in the web for reducing weight. Beams intended for roofs of small slope also are installed with a spacing of 6 and 12 meters. Beams that rest on subrafter girders are made in shortened form.

Roof girders for bays 18 and 24 meters are basically segmental, of two types: bracing and nonbracing. The girders can be installed with a spacing of 6 or 12 meters directly on columns or on subrafter structure.

Subrafter girders 12 meters long are installed along a row of columns in order that truss girders with a spacing of 6 meters may rest on them. Subrafter girders are made prestressed; weight of a member is 11.3 or 11 tons.

Roof slabs differ in material, shape and reinforcement. The choice of slab material—heavy, keramzit or cellular concrete—depends upon the purpose of the building, its temperature regime and the load on the roof.

Wall panels can be single-layer, made of heavy, keramzit or cellular concrete, or three-layer, in which the middle layer insulates against heat.

The mix of members for the buildings includes as basic members wall panels made of cellular concrete 6 or 12 meters long and 0.9, 1.2, 1.5 or 1.8 meters high. Single-layer panels are 160, 200, 240 or 300 mm thick. Panels 6 meters long can also be used for buildings with column spacing of 12 meters. In this case the panels are fastened by one end to the frame columns and by the other end to the frame columns that are installed specially for structure of the enclosing wall. The mix of members for building includes also completely preassembled members of smaller sizes.

In addition to the above-enumerated basic types of prefabricated reinforced-concrete members, other members and parts made at factories are being used in the construction of one-story industrial buildings.

Tie rods and cross-bracing are installed in the longitudinal direction of building bays between the columns and beams, or these members are made, as a rule, of rectangular cross-section. Their length is determined by the column spacing; the weight of the tie rods and crossbracing does not exceed 1 ton.

Lintels and girt beams are used basically for framing apertures during the erection of wall enclosures made of brick, and also in places where there is an overfall of the heights of individual bays.

Steel skylights for light and air 6 meters wide are used for buildings with bays of 18 meters, and 12 meters wide for buildings with bays of 24, 30 and 36 meters (series I.464-11 and 13). In this case the spacing of the truss structure can be 6 or 12 meters. The skylights are П-shaped and have vertical glazing. An exterior gutter is installed along the skylight on the roof, and the roof has a slope of 1.5 percent, 5 percent or 1:12. The skylight structure calls for the use of shaped roof decking on purlins) or standard reinforced-concrete roof slabs 3x6 and 3x12 meters.

The main members of steel skylights are the skylight panels and girders, and the end panels that join the girders and the purlins. The skylight panels that position the skylight glazing in sheets rest on the roof trusses. The length of the panels is 6 or 12 meters and depends upon the spacing of the roof trusses. The panel consists of a system of posts, horizontal members and sheet sheathing for the side of the skylight. The upper horizontal bracing for the skylight panels is formed by the skylight girders and end panels.

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METALWORKING EQUIPMENT

ABSOLUTE AND RELATIVE PRICE REDUCTION OF MACHINES

Moscow VOPROSY EKONOMIKI in Russian No 10, 1978 pp 38-46

[Article by Yu. Yakovets]

[Text] The chief content and purpose of scientific-technical progress is economy of worktime, reduction of outlays of living and embodied labor per product unit (with consideration of its quality). "The purpose of bringing in machines," K. Marx emphasized, "is, in its most general form, reduction of cost and consequently price of goods, making them cheaper, that is, reducing the worktime required for the manufacture of a product unit..."[1] The rate of lowering the cost of products can serve as a measure of the effectiveness of scientific and technical progress, a leading economic principle of which is absolute and relative price reduction of machines.

Absolute and relative price reductions of machines are interrelated forms of economic realization of scientific-technical progress, possessing common bases and consequences but different mechanisms of realization. Absolute price reduction contributes to the full development of the economic potential of a specific type of equipment, expressed in lower cost and price of manufactured equipment in proportion to the expansion of the scale of its production and reduction of expenditures. Relative price reduction reflects the economic result of transition to new, more efficient machines, ensuring higher productivity of collectivized labor.

The mechanism for achieving the first form of price decrease is periodic reduction of list prices of manufactured machines (in general revisions of price lists, changing over from temporary wholesale prices for fundamentally new equipment to permanent reduced prices for outdated machines; the second is setting lower (calculated per unit of useful effect) prices for new equipment intended to replace equipment that had been produced formerly.

In a planned economy, various methods are employed for the utilization of the principles of absolute and relative price reduction of equipment: periodic lowering of wholesale prices of machinery, instruments and equipment in proportion to reduction of production costs and obsolescence; employment of increases and reductions of wholesale prices of machine-building products;

employment of graduated wholesale prices; periodic general revaluations of fixed capital; allowance for obsolescence in determination of amortization norms of active part of fixed production capital.

Wholesale price lists should not be revised frequently so as not to undermine the stability of plan indicators of manufacturers and users of machines and the incentives for reduction of production costs. At the same time, price revisions should not be put off where conditions exist for cost reduction of machines. On the basis of study of actual tendencies over a relative long-term period of time (10-15 years), there should be determined normative time periods for revision of wholesale price lists of machine-building products and possible sizes of reduction of wholesale-price level provided by planned indexes of price changes in five-year plans. Rates of price reductions of machines differ significantly with respect to sectors. They are highest in radio electronics and instrument making and relatively low in heavy machine building.[2] Therefore for many price lists it is enough to lower prices once in five years combined with a general revision of wholesale prices, while for some types of equipment with higher rates of reduction of production costs and obsolescence, two or three times may be required in a five-year period.

Normative periods for revision of price lists (coordinated with periods for changes in normative-technical documentation) and assignments for lowering prices (plan indexes of prices for sectors and groups of products, long-term prices for the most important types of machinery and equipment) have to be included not only in the national economic plan but also in the plans of industries, associations and enterprises. This makes it possible to carry out timely preparations and to search for reserve capacities for reducing production and raising the technical level and quality of production.

In determination of maximum and wholesale prices for new equipment, special attention should be paid to the creation of and adherence to normative coefficients of its relative price reduction compared to equipment being replaced. It is advisable to differentiate these coefficients not only according to types of equipment but also according to degree of its newness (the highest--with development of the technical and economic potential of new generations of machines, the comparatively lower--with modernization of already known models of machines).

For relative price reduction of equipment, it is important to make fuller use of the mechanism of compensation for the costs of its development. For the initial basis of the price formation of a new machine, there should be used the normative cost of the series-production period of a given product in defraying costs of development (in a valid amount) at the expense of centralized funds (new-equipment development fund, unified fund of science and technology). Frequently the reason for relative price increase of new equipment is errors made in its design, but the main thing is inadequately worked out designs of new machines, lack of experimental plants, their being overloaded with the output of planned series of production. All this leads to large losses in the manufacture and use of new equipment. Such "economy" at the stage of introduction of new equipment holds back scientific-technical progress and reduces its effectiveness. Projected production cost and maximum price possess little basis under such conditions.

Absolute and relative price reduction of machines and their obsolescence must also be taken into account through the use of increases and reductions of the wholesale prices of the products of the machine-building industry, reflecting a change in the technical level and quality of products, their reproduction costs and operation of the time factor. In such cases, markups should be a source of additional economic incentive for planning and design organizations. For the user, it should guarantee an additional effect and consequently a price reduction for a higher-quality and technically more perfect machine. For obsolete machines, price reductions should be made, reducing incentives for the manufacturer in regard to the production of obsolete equipment and at the same time compensating for losses from their operation by users. As we know, the system of stimulating price increases and reductions, which is closely connected to the results of certification of product quality, has been used unilaterally so far. Whereas for products of the machine-building industry that have received the state Seal of Quality price increases and reductions are rather widely used, for products coming under the second category price reductions are usually not made. This retards the rate of price reduction and removal from production of obsolete machines. The proposal of some economists is hardly correct that in such cases price reductions should be made only for producers while retaining the former price level for users. This leads to losses by users of obsolete equipment and to higher prices for new machines.

The use of graduated prices for products of the machine-building industry has not become widespread, although it involves a progressive idea--to specify ahead of time in price lists the periods and amounts of price reductions for specific products. This permits taking obsolescence into account in a planned manner and providing for price reductions of machines (not only absolute but also relative, inasmuch as the initial basis for determination of maximum and wholesale prices of later machines will turn out to be lower), which mobilizes cost-accounting collectives to search out and to make all-out use of reserve capacities for cutting down production costs and upgrading its technical level.

Reference to the need for providing stability of plan indicators frequently serves as an argument against graduated prices. But value indicators and norms (including prices) should reflect processes taking place in economic practice and actively influence them. Inclusion in the plan of graduated prices and targers for reduction of production cost and of wholesale prices will strengthen the mobilizing effect of the plan for production efficiency and scientific-technical progress. The wide-scale use of graduated pricees and plan price indexes would require raising the level of long-term and annual planning of cost indicators of a plan as well as the working out of normative periods for renewal of production of machinery, equipment and instruments.

Periodically conducted revaluations of fixed capital make it possible to set prices for machines in accordance with the changing costs of their reproduction. Thus with the revaluation of fixed capital of 1 January 1960, the restorative value of industrial-production fixed capital decreased compared to initial cost by 2 percent and that of machines and equipment by 9.7 percent, while with the revaluation of industrial-production fixed capital of 1 January 1972, their restorative value increased by 9 percent, including machines and equipment by 6 percent (at the same time the value of computer equipment dropped 9 percent and that of measuring and regulating instruments --4 percent). This is due both to the rise of wholesale prices in 1967 and to inadequate accounting in the revaluation of machine obsolescence. It is evidently advantageous to carry out systematically and in a planned manner the revaluation of fixed capital (once in 10 years) while making more rigid requirements in regard to the valuation of obsolete equipment. This will permit not only to reduce all used fixed production capital to a single valuation, equalizing thereby cost-accounting conditions for enterprises and production installations that have gone into operation at different times, but will also serve as a method for absolute price reduction of existing equipment and for relative price reduction of new equipment.

A more complete calculation of machine obsolescence in determining amortization norms of the active part of fixed production capital presupposes a further increase in amortization norms for renovation (on the basis of reduction of the average service life of machines because of the scientific-technical revolution), first of all at the expense of reduced deductions for capital repairs. This will hinder artificial extension of the service life of obsolete and technically backward machines and sharply reduce expense and little-effective repairs. Thus for industry in 1976, deductions for capital repairs exceeded 12 billion rubles, which is 22 percent more than the total sum of cpital investments in machine building and metalworking.[3] At the same time it is necessary to expand significantly the production of new, technically more-advanced and more economic systems of machines for comprehensive replacement of obsolete equipment in modernization of existing enterprises. This constitutes a major reserve capacity for raising the efficiency of collectivized production.

The rate of absolute price reduction of new equipment may be judged by changes in indexes of wholesale prices which reflect direct (directive) changes in price-list prices without consideration of product assortment and quality (as well as the changeover from temporary prices for fundamentally new products to permanent ones).

As can be seen from the data in the table, the price index of manufactured machines, instruments and equipment has dropped on the whole. The average yearly rate of this drop varies significantly for different years. The figures are highest in periods when the price level in most sectors of heavy industry has either dropped (1951-1955--7.3 percent of average yearly prices) or at least not changed (1955-1960 and 1967-1973--3.3 percent of yearly prices). Rate of absolute price reductions for machines sharply slowed down when prices increased for fuel, power and metal (1965-1967--1.3 percent of

Rates of Absolute Price Reduction of Products of Machine Building and Metalworking

	Periods					
	1950-1955	1955-1960	1960-1965	1963-1967	1967-1973	1973-1976
Average yearly rates of wholesale price changes (in percent):						
all industry	-3.9	+0.3	+0.3	+4.9	-0.2	-0.4
sectors of heavy industry	-5.3	-1.4	-0.7	+8.7	-1.6	-0.3
machine building and metalworking	-7.3	-3.3	-1.4	-1.3	-3.2	-2.1

average yearly prices). Naturally, the rates of product price reduction of machine building have exerted an influence on the dynamics of expenditures and prices in other sectors of industry (both directly and indirectly--as the result of revaluation of the value of fixed capital).

Analysis of changes in the indexes of wholesale prices of enterprises of some sectors of machine building shows that rates of absolute price reduction are highest in comparatively young, rapidly developing sectors (machine building, radio electronics) and lowest in a number of sectors with metal-intensive products. The effect of price rises of products of raw-material sectors, especially rolled ferrous metals, is most perceptible in them.

Many machines whose prices are reduced are soon taken out of production. But it does not follow from this that in the given instance price reductions of machines do not provide real benefits to the user. When setting prices for new equipment, their level is determined by comparison with already reduced prices of products that are being replaced or the products of a particular parametric series. Moreover, in the formation of the normative production cost of machines, price reductions of component parts and units are taken into account. Consequently, price reductions of products of the machine-building industry expressed in the wholesale price index are a real economic result of scientific-technical progress.

At the same time, wholesale price indexes cannot reflect the degree of relative price reduction of equipment inasmuch as changes in product assortment and quality are not taken into account in their formation (account, however, is taken of the fact that prices change here in exact correspondence to changes in the use effect of products). The degree of relative price reduction of machines can be measured by comparing wholesale prices with the upper price limit of new products. But in this connection it should be kept in mind that in calculating of the effectiveness of new equipment, on the one hand, the upper price limit, the maximum price and sometimes the wholesale price frequently are raised excessively. Calculation of the effect is done in conformity with the potentialities of the new machine, which can be far from fully realized in the process of its operation. Moreover, cases are to be found of inefficient use of new and powerful equipment. Consequently there is occasionally observed growth of production cost and price of products manufactured with new equipment, which attests to the relative price increase of the latter. On the other hand, the methods use in evaluating the effectiveness of new equipment frequently result in its lowering, which narrows the economic use limits of machines. This occurs first of all when the use of the machines is aimed at economy of living labor, improvement of its use, as well as at conservation of natural resources, reduced pollution of the environment (since socially necessary expenditures for the reproduction of labor and natural resources are not fully reflected in production cost, and their cost-accounting evaluation is reduced excessively in comparison to the price of the machines).

In evaluating the effectiveness of new equipment, there should be taken into account factors influencing not only production cost (and value) of products produced with its power (reduction of specific size of amortization, economies in wages, expenditures on raw and other materials, fuel, power, and so forth) but also use value: the production of quality products or new use values, which could not have been manufactured with earlier machines. Consequently, calculation of the effectiveness of new machines and the degree of their relative price reduction must be considered as elements forming production expenditures and change of use value and higher product quality.

Improvement of methods of determination degree of relative price reduction of new equipment must proceed in the direction of fuller estimation of the social, ecological and external economic effects. The social effect of new equipment is expressed in improved conditions of labor stemming from its use. This contributes to better utilization and reproduction of manpower, reduces intensity of labor and the harmful effects of noise, decreases morbidity and makes labor less tiring and more creative. The ecological effect of new equipment and technology finds expression in the rational use of natural resources (reduction of losses in extraction of natural raw materials, greater integration of its processing, utilization of production wastes) and in the reduction of environmental pollution (introduction of waste-free technology, purification of effluent water and waste gases, and so forth). The external economic effect lies in the possibility of obtaining additional income from the export of new equipment surpassing the best world models, sale of licenses and also savings from the replacement of imported machines with domestic that are not inferior in quality and are cheaper.

The social, ecological and external economic effect of new equipment is indissolubly connected to the economic effect and can be considered as a variety of it and as an indirect economic effect (in distinction to direct, which is immediately determined by a comparison of expenditures of production of a machine with the savings obtained in the sphere of its use). For example, improvement of working conditions serves as one of the methods of increasing its productivity; reduction of losses of mineral materials in the course of their extraction relatively reduce the need for funds for prospecting and working of new mineral deposits.

The theoretical bases and methods of determination of all forms of indirect effect have been insufficiently worked out in the scientific plan. It is often ignored in practical technical-economic calculations. Effectiveness and degree of relative price reduction are thereby excessively reduced inasmuch as generally boosted social, ecological and external economic requirements are made on it.

At the same time it would be incorrect to justify the low efficiency of some new machines and their comparative higher cost in terms of improved work conditions. The decisions of the 25th CPSU Congress set as an objective with respect to the creation of new designs for machines, instruments and apparatus lower cost per unit of capacity (productivity). The same objective applied to agricultural equipment was emphasized at the July (1978) Plenum of the CC CPSU. As the result of introduction of new equipment, production costs and product prices should be reduced rather than increased, while the social and ecological results of use of the machines should be improved. Therefore, when increasing labor outlays for the improvement of social, ecological and other parameters of machines, it is necessary to carefully validate and regulate these outlays. The growth of the direct economic effect from the use of new equipment must be sufficiently large to compensate fully for the growing outlays on improvement of the social and ecological results of use of machines and at the same time to provide an additional economy for users.

A conducted analysis showed that in the Ninth Five-Year Plan and at the beginning of the Tenth, rates of absolute and relative price decrease of machines slowed down for a number of reasons: discontinuance of frequent price revisions while prescribed norms of profitability were being exceeded; higher prices for rolled ferrous metals; revaluation of fixed capital and raising of amortization norms; growth of prices for imported machines and equipment. But the main reason in our view is partial use of the laws of cyclical development and equipment and the relative reduction of the scientific-technical stockpile.

Technical progress is uneven. One may observe in this unevenness a certain pattern of periodicity in the transition to a qualitatively new level of equipment and to a new scientific-technical cycle. Reference is made not to stages of the life cycle through which each new model of a machine passes and not to the periodic replacement of machine models within the framework of a particular principle but to the transition to a new scientific-technical direction or to a new generation of machines. For example, the development of electronic computers opened up essentially new possibilities for increasing the efficiency of control of most complex technological and economic processes and established the basis for a new scientific-technical direction. Each subsequent generation of electronic computers is distinguished by much greater speed of information processing, growing diversity of models and fields of their use. Now a new scientific-technical direction is being developed--robot-equipment, which in its turn is characterized by a succession of generations of robots.

In the transition to a new scientific-technical cycle, its first phase is the longest and most complex. This period requires a fundamental development of the new technical idea, carrying out of applied scientific-research, design and experimental work, development and testing of experimental models, large investments into the remodeling of existing plants or the construction of new ones for series production of fundamentally new equipment and for its adoption in different spheres of use, training or retraining of cadres, and so on. This is followed by the phase of rapid growth of production of the fundamentally new equipment and the rapid growth of the effect stemming from it. Technical parameters of machines are improved, production cost and wholesale prices of them drop rapidly, expanding thereby the sphere of effective application of the new equipment. Then the third phase begins--a relatively stable development of the technical idea. Certain models are replaced by others that are better designed and more diverse but which no longer yield a significant growth of effect. The new technical idea and its marketed system of machines spread widely and are established on a firm basis in many spheres of use. But the rates of absolute and relative price reduction of the equipment slow down. In the fourth phase of the cycle, the potential of the given technical idea becomes practically exhausted and its further development is connected with large outlays, producing no perceptible effect and sometimes not justifying itself in the sphere of use: the new models of the machine are occasionally relatively more expensive. The moment arrives for the transition to a new scientific-technical cycle. The longer this transition is delayed, the greater are the losses incurred by society.

The length of the scientific-technical cycle on the whole and in its individual phases varies in different sectors, for example in electronics and in mining technology. But at the same time the movement of the cycle in each sector should not be examined in isolation. New promising scientific-technical directions lead to revolutions in the technical base for a group of technical related but at times extremely remote sectors.

At the present time, a number of industries are in the last phase of the technical cycle, when expenditure on the improvement of designs of machines and their modernization produce little additional effect. This is to be noted in power machine building and open-hearth production,[5] in agricultural machine building[6] and in other sectors. The economic literature emphasizes the urgent need for timely transition to a principally new level of equipment and technology as a most important factor for increasing the effectiveness of scientific-technical progress.

The transition to new generations of machines is often hindered by the defects of the utilized operational mechanism. In science and technology planning little consideration is given to the cyclicity of technical development and timely concentration of manpower and resources is not provided for the preparation and comprehensive balanced transition to the production and use of new generations of machines. As a result, such a transition frequently stretches over many years and does not produce the necessary effect. In standardization, price formation, economic stimulation and in state certification of product quality, a sufficiently differentiated approach is not provided to the fundamentally new equipment and technology and to products that are only modifications of long produced ones that have exhausted their potential in generations of machines.

On the basis of the law of the scientific-technical cycle, it is necessary to create favorable economic conditions for the comprehensive transition to qualitatively new equipment, producing a significant rise in labor productivity and efficiency of production, and also acceleration of the rates of absolute and relative price reduction of machines.

Reduction of the fundamental scientific and technical stockpile is an important reason for a certain slowing down of the rates of absolute and relative price reduction of machines and lag in the realization of the requirements of the scientific-technical cycle. We know that a certain proportionality must be maintained in the rates of development of science, technology and production: basic scientific research must stay ahead of applied research and technical development, which in its turn creates a stockpile for the outrunning of production of the new equipment compared to the rate of development of production as a whole.[7]

Statistical data, however, attest to the fact that these proportions are not always adhered to. The rates of growth of expenditures on science and the size of scientific personnel dropped perceptibly in the Ninth Five-Year Plan and especially at the beginning of the Tenth. There is occurring a relative reduction in the number of scientific personnel in institutions of the USSR Academy of Sciences and the academies of sciences of the union republics engaged primarily in basic research. In 1960 the share of scientific workers of these institutions in the total number of scientific personnel comprised 12.1 percent; in 1965, following the turnover of a number of general technical institutes to industry, it was reduced to 7.8 percent and in 1967 to 7.1 percent. Such a turnover, of course, strengthened the tie of scientific research with practice. But branch ministries to which general technical institutes are now subordinated as a rule put in the forefront current problems, pushing into the background theoretical research that creates a scientific-technical stockpile for the transition to basically new equipment and technology.

In science planning, it is necessary to devote more attention to an advancing development of basic research, providing it with cadres, material resources and guaranteed sources of financing. In the conversion of ministries to the new system of planning, financing and economic stimulation of work on new equipment, up to 20 percent of the funds of the united fund for the development of science and technology are allocated for conducting basic, theoretic and research scientific work, for design, planning-and-design and technological development for the creation in the sector of a scientific-technical stockpile. But criteria are not always determined for the assignment of research to basic or exploratory; problems of interbranch character frequently fall out of sight. Therefore it is necessary to relate closely basic research and development to the creation of a stockpile for the transition to new scientific-technical directions of technical development and to new generations of machines. It would be advantageous in our view to expand within the framework of the USSR Academy of Sciences basic general technical research of an interbranch character aimed at the development of new sources of energy and basically new materials and technological schemes and systems of machines.

It should be remembered that the technical ideas and technological principles employed in mass production have largely been exhausted. There is an increasingly acute need for the wide-scale development of basically new and much more effective equipment and technology. This would be impossible to achieve without concentration of resources on basic research and its advancing development without a clear-cut working mechanism of concretization of progressive technical ideas in the sphere of applied science and planning-and-design development and their materialization in the mass output and use of new equipment.

Reduction of the technical stockpile and the weakness of "bridges" which lead from applied scientific research to the design of new equipment prepared for inclusion in mass production are borne out by the following data. From 1951-1955 to 1961-1965, the number of developed models of new types of machines, equipment, apparatus and instruments grew 5.3-fold (including new models of instruments, automation equipment and computer equipment--17-fold), while in the last 11 years it decreased 18 percent (and instruments, automation and computer equipment--26 percent). It is true that the number of new types of industrial products developed by production and of obsolete designs of machines, equipment, apparatus, instruments and products taken out of production is steadily growing, which attests to the renewal of assortment and the technical perfecting of production.

Evidently, the reduction in the number of developed models of new equipment has been affected by the shrinkage of the fundamental scientific-technical stockpile and the reduction of attention on completion of scientific and planning-and-design developments suitable for the introduction of models of new machines and instruments and the inadequacy of the experimental base. It should also be remembered that enterprises and production associations are little interested in the development of principally new equipment as this is connected with considerable risk and with temporary deterioration of the economic indicators of work. The most important planning and accounting indicators of the development of technology should be in our view the number of created models of new equipment (with account being taken of their economic effectiveness), the number of models of new equipment actually assimilated by production and the sum total of the additional effect obtained from this. We need to look for aggregated indicators characterizing the transition to new generations and systems of machines.

The course taken by the party to raise efficiency of production and speed up technical progress raises problems of development and implementation of a complex of measures on the basis of an organic union of the advantages of the economy of developed socialism and the achievements of the scientific and technical revolution. A central place should be occupied among these measures by concentration of manpower and resources on the creation of a scientific-technical stockpile, making it possible to shift to a qualitatively new level of equipment and technology, planned use of the laws of cyclical development of science and technology, the creation of an operational mechanism systematically stimulating development and the introduction of new, more effective equipment and absolute and relative price reduction of machines.

FOOTNOTES

1. K. Marx and F. Engels, "Sochineniya" [Works], Vol 37, p 351.

2. In developed capitalist countries over the course of 10 years expenditures on the production of steam turbines and ships decreased on the average 37 percent, motor vehicles--53 percent, tractors--55 percent, relays--70 percent, components of electronic designs--90 percent. During 1963-1976, average prices of digital integrated circuits in the United States decreased to 1/268th of the initial level and linear to 1/400th (see Ye.I. Punin, "Nauchno-tekhnicheskaya revolyutsiya i mirovyye tseny" [The Scientific-Technical Revolution and World Prices]. Izdatel'stvo "Mezhdunarodnyye otnosheniya", 1977, pp 43-49).

3. See "Narodnoye khozyaystvo SSSR za 60 let" [60 Years of the USSR National Economy]. Jubilee statistical yearbook. Izdatel'stvo "Statistika", 1977, pp 438, 651.

4. At the same time, cases are not excluded where, computed per unit of useful effect, new machines turn out to be more expensive than earlier produced ones. But this is not taken into account in the making of indexes.

5. See V.G. Shteyngauz, "Ekonomicheskiye problemy realizatsii nauchno-tekhnicheskikh razrabotok" [Economic Problems of Realization of Scientific-Technical Developments]. Izdatel'stvo "Nauka", 1976, pp 37-38.

6. See A.P. Kolotushkina, "Tsenoobrazovaniye i tekhnicheskiy progress v sel'skokhozyaystvennom mashinostroyenii" [Price Forming and Technical Progress in Agricultural Machine Building]. Izdatel'stvo "Mashinostroyeniye", 1976, pp 38-42.

7. See L.M. Gatovskiy, "Nauchno-tekhnicheskiy progress i ekonomika razvitogo sotsializma" [Scientific-Technical Progress and the Economics of Developed Socialism]. Izdatel'stvo "Nauka", 1974, p 50.

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